

WHAT IS CLAIMED IS:

1. A DC-DC converter comprising:

a primary-side circuit for outputting energy of a primary coil of a transformer to a secondary coil side in accordance with an on/off operation of a switching element;

a secondary-side circuit for rectifying and smoothing a voltage output from the secondary coil of said transformer and for outputting a DC voltage;

an auxiliary power-supply circuit for rectifying and smoothing the voltage output from an auxiliary power-supply coil provided in said transformer;

a secondary-side control circuit for detecting the DC output voltage of said secondary-side circuit and for outputting a control signal;

a drive control circuit for outputting a pulse control signal for controlling the on/off operation of said switching element on the basis of the control signal output from said secondary-side control circuit;

an insulator for transmitting the control signal output from said secondary-side control circuit to said drive control circuit; and

a coupling device for superimposing, in an AC manner, the output of said auxiliary power-supply circuit onto the control signal transmitted to said drive control circuit; wherein

the output of said auxiliary power-supply circuit and said coupling device are directly connected to each other electrically.

2. The DC-DC converter according to Claim 1, wherein the secondary-side circuit includes a plurality of diodes, a coil, and a capacitor connected to the secondary coil.

3. The DC-DC converter according to Claim 1, wherein the auxiliary power-supply circuit includes a plurality of diodes, a coil, and a capacitor connected to the auxiliary power-supply coil.

4. The DC-DC converter according to Claim 1, wherein the auxiliary power-supply circuit generates a voltage for operating the drive control circuit and an output side of the auxiliary power-supply circuit is electrically connected to the drive control circuit.

5. The DC-DC converter according to Claim 1, wherein an output side of the drive control circuit is electrically connected to the switching element of the primary-side circuit.

6. The DC-DC converter according to Claim 1, wherein the insulator includes a photocoupler.

7. The DC-DC converter according to Claim 6, wherein the photocoupler insulates a primary side and a secondary side of the DC-DC converter.

8. The DC-DC converter according to Claim 1, wherein the coupling device includes a coupling capacitor arranged to extract only the AC components from the output signal of the auxiliary power-supply circuit.

9. The DC-DC converter according to Claim 1, wherein the coupling device includes at least one of a source follower circuit including an FET, an emitter follower circuit including a transistor, a high-pass filter circuit including an OP amplifier, and a transformer coupling circuit.

10. The DC-DC converter according to Claim 1, wherein the DC-DC convert comprises one of a forward DC-DC converter and a flyback DC-DC converter.

11. The DC-DC converter according to Claim 1, wherein a resistor is connected in series to the coupling device.